Original Article

Epithelial Migration in Open Mastoidectomy Cavities

C.A. Ong, Narayanan Prepageran, Sharad Godbole[1] and R. Raman, Department of ENT, University Malaya Medical Centre, Kuala Lumpur, and [1]Department of ENT, Queen Elizabeth Hospital, Kota Kinabalu, Sabah, Malaysia.

OBJECTIVE: To study the rate and pattern of epithelial migration in 18 dry, open mastoidectomy cavities.
METHODS: This was a prospective study of 19 patients who had undergone mastoidectomy at a secondary (state) hospital and a tertiary referral centre at least 6 months previously and whose mastoid cavities were dry and not infected. Their mastoidectomy cavities were cleaned and India ink dots applied in its medial aspect under microscope. The patients were followed up at 1 or 2 weekly intervals for a minimum of 3 months or until the dots disappeared, whichever came first. On follow-up, the cavities were examined under microscope. If migration was observed, the rate and pattern were noted.
RESULTS: Most (94.4%) of the cavities were noted to have epithelial migration laterally. No migration was observed in 5.6%. The start of migration of ink dots was noted in the 2nd week in 53% of the cavities, with a mean of 3.05 weeks. The mean rate of migration was 0.68 mm/week.
CONCLUSION: Epithelial migration appears to be predominantly lateral (94.4%), with onset in the 2nd week (53%) at a rate of 0.68 mm/week. Epithelial migration might not play an important role in accumulation of wax in open mastoidectomy cavities. [*Asian J Surg* 2007;30(1):57–9]

Key Words: epithelial migration, mastoidectomy cavities

Introduction

The stratum corneum of the skin on the surface of the body is shed due to friction. The skin of the normal external ear canal and tympanic membrane is different. Epithelial migration is a unique physiological response in the ear to ensure that shedding of the skin is not accumulated, but migrated out of the ear.

Mastoidectomy is a surgery commonly performed for patients with cholesteatoma. Postoperatively, some patients' mastoid cavities are clean and dry, but some lose the self-cleansing property with debris accumulating in the cavities. Loss of self-cleansing property is due to the loss of epithelial migration or to an abnormal migration pattern in the cavities.

To date, only two studies have been conducted to investigate epithelial migration in open mastoidectomy cavities, both in Europe in 1994 and 1995, respectively.[1,2] This study was performed to explore and investigate whether epithelial migration occurs in our patients in an Asian setting, and the pattern and rate of migration if it occurs, as compared to the results of previous papers.

Patients and methods

The inclusion criteria for selection of patients were: have undergone open mastoidectomy at least 6 months previously and mastoid cavity is dry and not infected. A total of 19 patients (21 open mastoidectomy cavities) were included. Sixteen patients were from Queen Elizabeth Hospital, Sabah. Three patients were from University Malaya Medical Centre, Malaysia. There were 10 male and nine female patients with ages ranging from 17 to 66 years. Mastoidectomies were performed between 1970 and 2002.

Address correspondence and reprint requests to Dr Narayanan Prepageran, Department of ENT, University Malaya Medical Centre, 50603 Kuala Lumpur, Malaysia.
E-mail: prepageran@yahoo.com • Date of acceptance: 20 April 2006

All of them had either a modified radical mastoidectomy or radical mastoidectomy through postauricular incision. All the cavities have low facial ridge and large meatoplasty.

Patients who consented to the study had their mastoid cavities meticulously cleaned under microscope. Then, seven dots of India ink were painted on the medial wall of the cavities in the shape of a hexagon using a thin wooden stick. The dots were placed 1 mm apart from each other. The anterior-most dot was placed 1 mm posterior to the facial ridge. The centre dot was placed halfway superior-inferiorly in the mastoidectomy cavities. Patients were sent home with the instruction to keep their ears dry, not to clean inside their ears and to get treatment as early as possible if they have upper respiratory tract infection. This study was performed by one investigator to reduce investigator error.

The patients were reviewed every 1 or 2 weeks for 3 months or till the dots disappeared, whichever came first. On review, patients were questioned for any symptom of the ear. Then, the mastoid cavities were inspected under microscope. Measurements were taken using a malleable wire if there was any migration of the dots observed. The pattern of migration was also noted in each cavity.

Results

From a total of 21 mastoid cavities, three cavities had discharge in the early stage of the study and the dots had disappeared by the first review. Thus, these were excluded from the study. Out of the remaining 18 cavities, epithelial migration was demonstrated in 94.4% ($n = 17$) with 64.7% ($n = 11$) migrated inferiolaterally, 23.5% ($n = 4$) radiate out laterally, 5.9% ($n = 1$) laterally and 5.9% ($n = 1$) superiolaterally (Figure 1). There was no migration observed in 5.6% ($n = 1$).

The start of migration of ink dots was observed in the 2nd week in 53% (nine cavities). Seventeen percent ($n = 3$) were observed in the 3rd week, 12% ($n = 2$) in the 4th week, 12% ($n = 2$) in the 5th week and 6% ($n = 1$) in the 7th week (Figure 2). The mean was calculated at 3.05 weeks.

The rate of migration was measured at 0.5 mm/week in 58% ($n = 10$), at 0.75 mm/week in 12% ($n = 2$) and at 1 mm/week in 30% ($n = 5$) (Figure 3). The mean rate of migration was 0.68 mm/week, or 0.10 mm/day.

Discussion

Epithelial migration is observed in all normal ears with intact tympanic membrane. The migration pattern is centrifugal from the umbo of the tympanic membrane.[3–5] The rate of migration was determined as ranging from 0.03 to 0.16 mm/day, averaging 0.05–0.07 mm/day.[6–9]

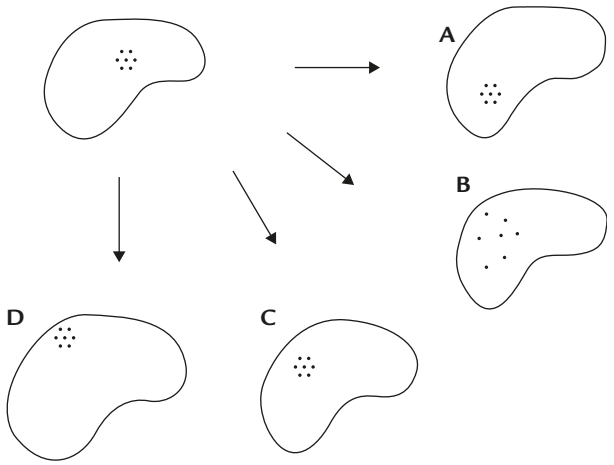

Figure 1. Pattern of migration observed in right mastoid cavities: (A) inferiolaterally = 64.7%; (B) radiate out laterally = 23.5%; (C) laterally = 5.9%; (D) superiolaterally = 5.9%.

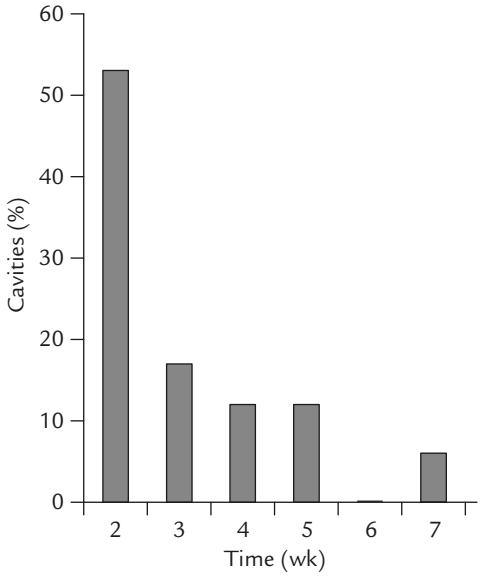

Figure 2. Onset of epithelial migration.

Modified radical mastoidectomy is a common surgery for patients with cholesteatoma. Postoperatively, some patients have problems with accumulation of debris in their mastoid cavities while others are symptom-free. This could be due to a change in epithelial migration, which gives the ears its self-cleansing properties. This study shows that epithelial migration does occur in open mastoidectomy cavities. The start of migration at 3.05 weeks (mean) was comparable with a previous study by Youngs, in 1995, which was 3.94 weeks.[1] All migrations were in the direction of going out from the centre of the mastoid cavity

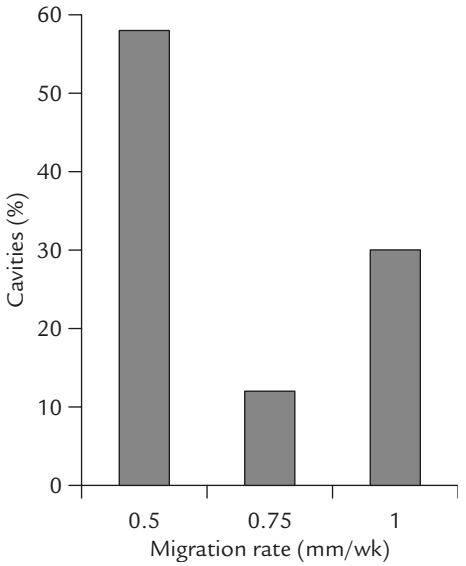

Figure 3. Rate of migration (mm/week).

(laterally). The mean rate of migration of 0.10 mm/day is similar to the rate reported by Bonding and Charabi in 1994.[2] They observed that the rate of migration in the cavities was between 0.02 and 0.45 mm/day. They also observed that the pattern of migration in cavity ears was centrifugal from the centre or upper part of the tympanic membrane. The migration pattern was similar in small, medium-sized and large cavities.

In this study, four types of migration pattern were observed, namely inferiolaterally (commonest), radiate out laterally, laterally and superiolaterally. All migrations were seen in the direction of moving out of the cavity. Similar patterns were noted in reconstructed open cavities.[10] In this study, there was one clean cavity that did not show any migration. This may be due to very slow migration, which was not noticed during the study period, or there was really no migration at all.

Clinically, most open mastoidectomy cavities have accumulated wax and need to be cleaned periodically. With a migration rate of 0.10 mm/day, which is slightly faster than the average migration rate in a normal ear of 0.05–0.07 mm/day, this suggests that epithelial migration might not play an important role in prevention of accumulation of wax in open mastoidectomy cavities. Another possible reason may be due to epithelial migration in other parts of the cavities, which do not move outward, causing accumulation of wax.

Other factors, which may affect epithelial migration in mastoid cavities, include surface of the cavities and the presence of debris or infection. A cavity with smooth surface may facilitate migration compared to an uneven surface. Uneven surface, sharp ridges and pockets in the cavities will cause accumulation of crusts/debris, and will then slow down the migration. Infection will cause changes in the epithelial surface. Micro-organisms and inflammation may slow down or stop the migration of the epithelium.

The limitations in this study included small sample size. Only a small area near the facial ridge was studied. Other areas may have different migration rates or no migration as noted by Bonding and Charabi.[2] All dots were of the same colour. Thus, rotatory migration cannot be excluded. There was also difficulty in measurement due to the uneven surface in the cavities. Animal studies by Johnson and Hawke indicated that migration in normal tympanic membrane and ear canal probably occurs in the deeper layers of the epidermis, and that it stops at the junction of the deep and superficial parts of the ear canal.[11] Whether this holds true in mastoid cavities is not established.

Epithelial migration appears to predominantly radiate outwards laterally (94.4%), with onset in the 2nd week (53%) at a rate of 0.68 mm/week in our study. Epithelial migration might not play an important role in accumulation of wax in open mastoidectomy cavities.

References

1. Youngs R. Epithelial migration in open mastoidectomy cavities. *J Laryngol Otol* 1995;109:286–90.
2. Bonding P, Charabi S. Epithelial migration in mastoid cavities. *Clin Otolaryngol* 1994;19:306–9.
3. Michaels L, Soucek S. Stratified squamous epithelium in relation to the tympanic membrane: its development and kinetics. *Int J Pediatr Otorhinolaryngol* 1991;22:135–49.
4. Moriarty BG, Johnson AP, Patel P. Patterns of epithelial migration in the unaffected ear in patients with a history of unilateral cholesteatoma. *Clin Otolaryngol* 1991;16:48–51.
5. Boedts D, Kuijpers W. Epithelial migration on the tympanic membrane. An experimental study. *Acta Otolaryngol* 1978;85:248–52.
6. Blake C. The progressive growth of the dermoid coat of the membrane tympani. *Am J Otol* 1882;4:266–8.
7. Litton WB. Epithelial migration over tympanic membrane and external canal. *Arch Otolaryngol* 1963;77:254–7.
8. Alberti PWRM. Epithelial migration on the tympanic membrane. *J Laryngol Otol* 1964;78:808–30.
9. Makino K, Amatsu M. Epithelial migration on the tympanic membrane and external canal. *Arch Otorhinolaryngol* 1986;243:39–42.
10. Pau HW, Hartwein J. Epithelial migration following surgical obliteration of radical cavities. *HNO* 1990;38:92–4.
11. Johnson A, Hawke WM. An ink impregnation study of the migratory skin in the external auditory canal of the guinea pig. *Acta Otolaryngol* 1986;101:269–77.